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UNITED STATES DEPARTMENT OF AGRICULTURE

DEPARTMENT BULLETIN No. 1270

Washington, D. C. ▼ October 11, 1924

THE PRODUCTION OF NARCISSUS BULBS

By

DAVID GRIFFITHS

Horticulturist, Office of Horticultural Investigations
Bureau of Plant Industry

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By David Griffiths, *Horticulturist, Office of Horticultural Investigations, Bureau of Plant Industry*

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EXPLANATION OF TERMS

The plants discussed in this bulletin belong to the botanical genus Narcissus which forms a considerable section of the Amaryllis family. The name was applied by the Swedish botanist, Linnæus, after the mythological Greek youth who was transformed into the flower.

The common names of the genus are two in number: (1) The generic name (narcissus) unchanged and (2) daffodil. Both of these are coextensive with the generic name. Although the latter had formerly a more restricted meaning, it has now come to mean, in the more authoritative writings, the genus Narcissus. In this bulletin the endeavor has been made to conform to this usage. "Jonquil" is a term properly applied to the natural species *Narcissus jonquilla* and its derivatives. They are the rush-leaved members of the genus.

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Common usage of these names varies greatly. For example, the florist trade has very largely substituted jonquil for the Long Trumpet daffodil, and in some sections the common name narcissus is employed to designate the Poeticus and Polyanthus groups only, while all the others except the jonquils are referred to as daffodils.

Further information on the use of names can be gleaned from the discussion of the classification on page 29.

SECURING STOCKS FOR PLANTING

One of the most difficult and expensive items in the production of narcissus bulbs for our home market is the propagating stock required to initiate the venture. This planting stock is both difficult and expensive to get, for the grower needs more than 300,000 bulbs of all sizes to plant a commercial acre intensively and about 100,000 to plant on the "American plan." Of the larger sizes, 100,000 to 175,000 bulbs to the acre would be sufficient. Manifestly the initial expense is prohibitive except under a capitalization too heavy for many private individuals to bear, if the grower is dependent upon the supply of first-quality bulbs for his propagating materials.

Fortunately, it may not always be necessary to buy such expensive materials, although some growers and possibly most of those now starting to produce daffodils in this country have started their stocks this way from bulbs offered for sale in autumn for florist and bedding uses. Possibly the best way to start is to buy bulbs by the bed as dug, getting all sizes, but this plan is impracticable at the present time in this country, where there are few established growers. This avenue is open to few except those who can establish foreign connections or who have a venture large enough to enable them to make such a connection. Such propagating material is available, however, to the foreign grower at more reasonable prices. Such stock is regularly sold in Europe by the bed, by the hectoliter, or by the bushel.

There are in this country a few established plantings. Some of them are very old. They contain the most common and in some cases very old varieties. Nevertheless, these are an asset that may be utilized as far as they go for the establishment of commercial plantings. It should be emphasized that it is in these old established plantings that one is likely to find the most vigorous healthy stock.

Very great quantities of bulbs come into the country each autumn, which are used for bedding. These stocks are mostly prime materials, if not in size, then certainly in most cases in quality. If the prospective grower is so situated that he can secure this stock as it is gouged out of the beds in late spring preparatory to putting in summer bedding plants, he will have planting stock which will be even superior to an equivalent number of bulbs purchased the following autumn, especially if advantage is taken of the opportunity of culling in the beds. Such bulbs left in the beds until the flowers fade will all flower the next year if properly handled and will produce some propagation in addition. This is not all. The bulbs that flower will become first-class stock with the first-year's growth under field conditions and will make some propagation, although not a full quota, while the propagation produced under the orna-

mental bedding conditions will grow up and most of it will flower the second year.

Most of the three main Dutch bulbs which come into the country by the millions each autumn are employed by florists in the production of flowers for winter consumption. The millions of narcissus bulbs thus used go to the rubbish heap as soon as the flowers have been cut. The idea has grown up in the florist business that this is the only use to be made of forced stock, and possibly for the ordinary greenhouse man in his cramped quarters this is true so long as bulbs are cheap. Nevertheless, as a general proposition it is a very wasteful practice, and herein exists a fertile source of propagating stock at low cost. To be sure, this material is not as good by any means as the bedded stock described above, but the big bulbs should all flower the second year and many of them the first and by that time have a propagation which will more than equal the original planting.

In spite of the oft-repeated and usual statement that forced bulbs are of no value, it is noted that foreign growers for some time have been offering as high as $20 per thousand for certain expensive varieties of bulbs after they have been forced, to be shipped back to the Netherlands. If the rare forms have such a value after being forced the cheaper ones are certainly not without merit and at least can be brought back to first-class condition again as truly as the higher priced ones. Under American conditions of scarcity and high price of stocks this source of supply can and should be used. The statement sometimes heard that the florist can not afford to take care of this material has no weight, for the simple handling of the flats is a matter of small expense and can easily be provided for. Few florists will forego a small return on the forced bulbs, even if they make no more than wages out of the handling.

Even with an extensive bulb industry established, this forced material should not be wasted. It would be economy even under extensive production to use these forced stocks rather than depend upon the ordinary field methods of reproduction. Even forced bulbs cut at the surface of the flats when in flower can be brought back to prime condition again as easily as the smaller half of the splits from field propagation.

Many times there is a decided advantage in the use of the bedding and forced stocks over freshly imported materials of equal monetary value. The opportunity for culling which occurs in the beds and in the flats is a factor not to be disregarded. Diseases, weak plants, and rogues difficult to detect in daffodils will be discovered in the beds and flats and can be culled; or, if bad, the entire stock can be rejected, protecting the fields from inoculation and the grower from the expense of a year's culture of stocks which may later prove costly to clean up.

It should be noted that in all references to forced stocks those are meant which have been forced into good flowering condition and even all leaves cut off at the surface of the flats. It is seldom, however, that all daffodil leaves are removed with the flowers in forced stock. Any leaves uncut and left to mature on the plants help to build up the bulb.

Some growers are now utilizing this forced material very effectively. One instance is known in which the florist grows Emperor

mainly for the leafage, cutting no leafage from his Golden Spurs, all bulbs of which are allowed to ripen naturally in the flats, planted out the next year to recuperate, and then forced again the second or third year.

HOW BEDDING AND FORCED BULBS SHOULD BE HANDLED

The normal thing is to leave these bulbs undisturbed after flowering until the tops die down naturally. This time, for stocks grown out of doors, will vary from May 10 to July 15, depending upon the season and the locality. When premature digging or removal of the foliage occurs, as in forced stocks, the natural development of the bulb is interfered with. The endeavor should be to handle them in a way as nearly natural as possible. There is, however, much latitude in the possible methods of handling.

Bedding daffodils removed from the beds as the flowers fade have been dug by the writer with the tops on. Some have been heeled in on sandy soil in the field, some in sand on the north side of a building, some stored in crates to dry in a root cellar, and some under the shade of trees with only the foliage covering the bulbs. This work, however, has not been done with counts and measures in a manner careful enough to enable one to say definitely the extent of superiority of one method over another. All that can be said is that all of these methods of handling have produced bulbs which flowered the next year with a bulb production of first quality, but with doubtless a reduced size of bulb and with only a slight reduction in the size of the flower. In these handlings, as in the case of normally grown field stocks, the bulbs have been taken up and stored on shelves as soon as the tops dried up. This requires only two or three weeks in the climate of Washington, D. C.

Forced bulbs available as propagating stock for the grower are usually in flats of two to three dozen each. It is the common practice to cut the plants off at the surface of the flats. This is strictly true in tulips. In daffodils there are usually some leaves left on the plants. As it is desirable to preserve and protect the flats as much as possible, the contents can be dumped out in a shed or in a shady place under trees, if the weather permits, to dry out and mature slowly. The length of time this will take will depend upon weather conditions. Four to eight weeks will usually be sufficient to put the bulbs in shape to be taken out and put on shelves. If all the leafage has been cut off, the matted flat content can be piled up two to four or more deep with little or no disadvantage.

The method of caring for the bulbs up to the time of planting will depend again upon the locality and the atmospheric conditions. It should be noted that these forced and bedding bulbs are coming out of the ground earlier than normal stocks by four to six weeks. This means that they are going to dry out for that additional length of time before the planting season arrives. In the cool damp climate of Puget Sound, Wash., that may not be a serious factor, but in the Atlantic Coastal Plain, where the temperatures run high during the season from June to September, the bulbs will need protection from excessive desiccation. They are best kept in cool cellars or half cellars, and they may need covering with dry sand, grain chaff, or

burlap to prevent excessive drying. The handling will not be essentially different from the handling of normal stock.

PREPARATION OF THE BULBS FOR PLANTING

In order to distribute plant material uniformly for the purpose of cropping all areas alike, careful sizing of the planting stock of bulbs is advisable. This is accomplished fairly well by separating the bulbs into four sizes, which are the main ones used in the investigations of the department. The circumference of the bulbs of different sizes in centimeters and the number planted to the row are as follows:[1] Bulbs 10 to 12 centimeters in size, 11 to the row; 8 to 10 centimeters, 14 to the row; 7 to 8 centimeters, 21 to the row; 5 to 7 centimeters, 35 to the row.[2]

Bulbs of larger size are planted 9 or even 7 to the row. At times stocks under 5 centimeters are to be planted and are put in as close as 50 to a row. It has been our practice to set up none of the larger daffodil bulbs measuring less than 10 or 11 centimeters.

PREPARATION OF THE SOIL

For good results the soil in which daffodils are planted should be naturally friable and well and deeply cultivated. The importance of this will be seen when it is realized that the roots go down in soil of the proper tilth 12 inches, and the bulbs are set 4 inches deep. It is evidently necessary to have the soil in tilth to such depth that the roots can penetrate easily and without getting into water standing over a hard impervious subsoil. Thorough pulverizing, rendering the soil friable and of easy penetration by moisture, is imperative. The necessity for such preparation will be all the more apparent with a realization of the possibility of deep culture no more frequently than once in two years.

PLANTING

The planting of daffodils does not differ essentially from the planting of many other bulbous stocks. In this country no general practice has been established, but in foreign countries, particularly the Netherlands, the bed system is universal. These beds are 1 meter (3 feet 3 inches) wide, alternating with 12-inch paths. This is the most intensive method of culture.

The growers of Paperwhite Grandiflora bulbs in both California and Florida plant them 2 inches apart in rows 15 inches apart. Some growers in Florida plant in single rows 2 to 3 feet apart and employ horse or tractor cultivation. The growers of daffodils for cut flowers in portions of Virginia use the wider row space and employ horse cultivation or frequently none. In some cases double rows, about 3 feet on centers, are employed.

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[1] The rows referred to in this bulletin extend across a 3-foot bed and are 6 inches apart.

[2] 12-centimeter bulbs are approximately $1\frac{1}{2}$ inches in diameter.
10-centimeter bulbs are approximately $1\frac{1}{4}$ inches in diameter.
8-centimeter bulbs are approximately 1 inch in diameter.
7-centimeter bulbs are approximately $\frac{7}{8}$ inch in diameter.
5-centimeter bulbs are approximately $\frac{5}{8}$ inch in diameter.
1 centimeter in circumference equals approximately one-fifth inch in diameter.

The bed system is the most exact and is the one employed in the cultures described here. In it the bulbs are all placed in geometrical design, the position of each bulb is known, and there is consequently less loss from cut and lost bulbs than is the case in more extensive methods.

In planting in the bed system the soil is thrown out of the first bed to the depth of 4 inches or more, the bottom of the depression is raked smooth, and a marker is run through to mark the edges and the center of the bed, as well as the rows 6 inches apart across the bed. (Pl. I, fig. 1.)

After the bulbs have been set the second bed is opened like the first, but the soil removed is used in covering the bulbs in the first bed. The remainder of the plat is planted by repeating these processes.

In row planting, whether in single or double rows, the depression for the reception of the bulbs is made with a plow, a single-shovel cultivator with wings attached, or even at times with a wheel hand implement. With the first two methods a rake is sometimes used, as in the bed system, to level the bottom of the trench. The danger with a wheel hand plow is that the bulbs are not placed deep enough. The large bulbs require that the beds be opened nearly 5 inches deep. The smaller bulbs can be set a little shallower.

TIME OF PLANTING

The advice of a leading Netherlands grower of bulbs to an American, "Plant as early in September as possible," is good. The grower of imported bulbs, however, can seldom get his stocks delivered so as to plant before October.

In the handling of domestic stocks, however, it has been the practice of the Department of Agriculture to plant much earlier. Planting time in these experimental investigations of recent years has been in August. In past years planting has been delayed sometimes even to December, but the earlier date is greatly to be preferred.

There have been two reasons for the earlier planting: (1) Our labor returns to school September 1, and (2) in the Puget Sound region labor efficiency is likely to be interfered with by copious rains in September, and the weather in October is likely to be so wet that it is not practicable to try to operate on the heavy soils on which the work is being conducted.

To summarize, daffodil bulbs can be planted from August to December, but for best results in commercial production they should, if possible, be set by the end of September.

AUTUMN TREATMENT OF THE BEDS

When daffodils are planted the soil is left rough as it drops from the shovel. It is allowed to settle naturally. No effort is made to pack the soil. This is accomplished by the rains much more effectively than is necessary. Really no attention need be paid to the plantings after the bulbs are covered until the weeds begin to grow. As weed seed germinates a wheel hoe with weeder knives is run over the beds as often as is necessary to keep them scrupulously clean until the weather is too cold for weeds to grow. Even the ubiquitous

chickweed succumbs to this treatment. If it is kept down absolutely until it is too cold for it to grow there is little trouble with it in the spring.

CULTIVATION

The cultivation of daffodils when planted in beds is a comparatively simple matter and neither burdensome nor irksome if the labor is performed punctually. Contrary to the general belief, but little handwork is necessary on the beds except with certain varieties which are weak growers, do not cover well, or do not for any reason make thick or perfect stands. Toward spring the use of the weeder knives must be dispensed with, and some form of scratching or harrow attachment must be used in the cultivation.

After the plants are a couple of inches high no form of wheel-hoe cultivation is practicable on any miscellaneous planting of daffodils, and with most of the vigorous varieties none is necessary, for soon after this they cover the ground so as to keep weeds down quite well (Pl. II). Weeds can not be much of a factor in a crop of this kind. After this there is a reversal of the cultivation. Weeds will still grow in the paths, where there is less shade and competition. The cultivation before the plants are up is done across the beds usually, but after this it is directed along the paths only.

When the variety for any reason does not cover the ground fairly well by the time it is in blossom, handwork is necessary. In this case a light narrow hoe with the blade about 3 inches wide is preferred to be used between the 6-inch rows. A three-prong cultivator hoe is also employed. One good job of cleaning out the weeds is usually all that is necessary even here.

In regions where weeds grow all winter the case is different and the bed system to a proportional degree is less advantageous.

MULCHING

It is reported that daffodils are mulched in the Netherlands the same as hyacinths, but only about half as heavily. In this country mulching is nowhere practiced, so far as is known, unless the thin coating of manure which is added for fertility the season they are not dug may be considered a mulch. In the region of Bellingham, Wash., it has not been considered necessary, but no comparative tests have been made with and without it. It is realized that a mulch might be necessary on certain soils which heave badly, but the advice here should be to keep off of such soils.

There is, however, no injury from a mulch with daffodils as there is with tulips, and so far as a manure mulch is concerned the bulbs are tremendously benefited by the fertility added in this way, but here no thought is given to a mulch for protection from cold.

SPRING WORK ON THE BEDS

Aside from the cultivation and roguing there is little to do on the beds in the spring until the tops die down in late June. At this time it has been the practice to hoe the beds and remove all the débris from them with a rake. This débris, consisting of leaves of the plants and weeds, should be composted and put on ground not to be used

in growing bulbs. On Puget Sound in the year when the bulbs are not dug they are gone over occasionally during the summer with a wheel hoe to keep them free from weeds. In more southern climates it is a good plan to sow cowpeas, soybeans, or velvetbeans, as the crop is laid by in the year it is not dug. This can be cut off in the fall; or, better, it can be rolled down, chopped up slightly, and left as a mulch. If it is heavy it may assist in keeping weeds down the next year. In the handling of this cover crop one must be governed by the weed situation.

SECOND YEAR OF THE BIENNIAL CROP

The handling of the crop the second year does not differ essentially from the first. The most important thing is to keep weeds down thoroughly as long as the weather is warm enough in early winter to let seed germinate. Then in the spring the wheel hoe is used in the paths, the few weeds which have escaped are removed, and roguing is attended to again.

ROGUING

Inadvertent mixtures are prone to take place in bulb culture. For this reason, if for no other, two crops of these bulbs should not succeed each other, for there is no surer way of mixing stocks. During the time the plants are in blossom these stray individuals can most easily be detected and removed by the use of a special spud which has a long stout blade, 2 to 2½ inches wide, set in a strong handle. Several examinations of the plantings are necessary during the season, going over them bed by bed to detect plants which are growing in other than their proper places. In removing the plants the spud blade is driven down close to the bulb, then by prying on the handle the roots are broken off, and the whole plant may be pulled up easily.

This process of roguing is a very important one, not only in daffodil culture but in the culture of all bulbs, for if the grower neglects this aspect of the work his stocks will soon be in such condition that they can be sold only as cheap mixtures.

DISPOSITION OF THE ROGUES

Whenever the rogues are identifiable and of desirable varieties they can be segregated and heeled in at the ends of the beds in which they belong. When dug they can be included with the planting stock. They will make first-class bulbs after another year's growth. More often, though, the rogues are heeled in together in some place out of the way where they can be disposed of when dug as the cheapest of mixtures.

DIGGING

The digging of daffodils does not differ materially from the digging of any other bulbs. When the tops die they are commonly hoed off. The digger starts in at the end of the bed with a short-handled spade and takes out row after row in succession along the bed. In heavy soils like the Whatcom silt, upon which the work

FIG. 1.—PLANTING DAFFODILS.

FIG. 2.—THE SAME BULBS SHOWN IN FIGURE 3, AFTER DRYING FOR TWO WEEKS AND HAVING THEIR ROOTS REMOVED.

FIG. 3.—POETAZ ELVIRA BULBS IMMEDIATELY AFTER DIGGING.

Note that the roots are still fresh. These have grown in two years from 10 to 12 centimeter slabs. They are now 15 to 16 centimeters in size and double nosed, with two or three slabs which can be taken off for propagation.

FIG. 1.—A FIELD OF VAN WAVEREN'S GIANT THE SECOND YEAR AFTER PLANTING BULBS OF ALL SIZES.

FIG. 2.—APPEARANCE AND HEIGHT OF BEDS OF MRS. LANGTRY THE SECOND YEAR AFTER PLANTING SMALL BULBS.

FIG. 1.—THE SHAKER USED TO REMOVE THE SOIL FROM A BUSHEL OF BULBS AT ONE TIME.

FIG. 2.—DIGGING DAFFODIL BULBS.

FIG. 1.—SIZING DAFFODIL BULBS OVER A GRADUATED GRATING OF PARALLEL BARS.

FIG 2.—BREAKING APART THE CLUMPS OF DAFFODILS AND PICKING OUT THE LARGE BULBS.

of the department is being conducted, it is necessary to remove a layer of soil 6 inches wide and about 2 inches deep across the bed by sticking in the tool and pulling toward the digger. This commonly exposes the tips of the bulbs, which then can be removed one or two at a time by another jab of the spade. (Pl. III, fig. 2.)

The bulbs are placed in windrows as dug and remain there until dried out somewhat, when they are covered with débris. How long they remain in the windrow and how they are handled there depends upon weather conditions, facilities for handling, and other factors. In the Puget Sound region the bulbs can usually remain exposed for a day or two if it is not extraordinarily hot. If, however, the bulbs are small and free from dirt they should be watched very carefully, for even in this cool climate some varieties are likely to be injured by the sun. In heavy soils the bulbs come out of the ground with a great deal of dirt on them and are consequently not easily injured. Sir Watkin bulbs, especially in the smaller sizes, are likely to be injured even here by the sun. In the Virginia region, however, the bulbs should not be sunned at all, for an hour of strong sun here will all but ruin many daffodil bulbs which are exposed.

The bulbs are shaken out with the right hand and thrown into windrows in the path. When possible two beds are thrown together. The marking stake is removed from its place in the center of the bed to a corresponding position in the windrow and left there until the bulbs are removed from the field.

In the culture of the Polyanthus group in rows in the South the rows are barred off with a 1-horse plow. The same plow, sometimes with the moldboard removed, is then run under the row. The bulbs are then picked out of the loosened soil. Some growers try to dig their stocks before the tops are completely dead. It is then possible to get them out of the loosened row by the tops and throw them in piles, much as onions are commonly handled. In the 15-inch row planting the digging is commonly done with a spading fork. Digging before the tops are dead should be discouraged.

DAFFODIL AND TULIP DIGGING COMPARED

It is harder work to dig daffodils than tulips for two reasons: (1) The daffodils usually remain in the ground two years; (2) in the Puget Sound climate the roots of the daffodils do not die. They are very firmly anchored to the ground at digging time and require a strong prying with the digging tool to get them loose. In California, and even in the Atlantic Coastal Plain, especially if digging is delayed, the roots disappear on most varieties.

REMOVING LOOSE SOIL FROM THE BULBS

The implement employed to remove the soil from the bulbs after they dry in the windrow for a short time is commonly called a shaker. It consists of a rectangular box 28 inches wide, 6 feet long, and 8 inches deep, having a bottom of a half-inch wire mesh. The box has a handle at one end and at the other the wire screen terminates a foot from the end. Over this opening is fastened a sack from which the bottom has been removed. Through this sack the bulbs when cleaned are dropped to the lug boxes automatically by

a slightly different motion from that used in cleaning. (Pl. III, fig. 1.)

The box container is hung in a stout frame so that it can swing backward and forward with a sort of jerking motion which slides the bulbs from one end to the other. The removal of a movable partition in one end and a slightly modified shake drops the bulbs into the lug box on the ground without handling.

When daffodil bulbs are fairly well dried, about a dozen oscillations of the bulbs from one end of the screen to the other is sufficient to remove the loose dirt from a load consisting of about a bushel of bulbs. Then four more jerks of the handle again drop the sieved bulbs into the lug box.

It takes three men to operate this machine advantageously, two at the machine and one to bring the bulbs and take them away.

A modified form of this shaker consists of the screen-bottomed box pivoted on a piece of pipe supported on two stakes driven into the ground. The box is then oscillated through a small arc, allowing the bulbs to slide from one end to the other, thus screening out the soil.

STORAGE

The method adopted for handling the bulbs as they leave the field is of great importance, for the labor connected with it is heavy. A good crop of daffodils will yield 800 to 1,000 lug boxes to the acre. These when brought in will weigh more than 50 pounds each and measure nearly a bushel. The number of handlings must therefore be reduced to a minimum, and the space used to store them must be economized.

It is believed that it is scarcely practicable to erect buildings and provide shelving to handle a large acreage of these bulbs grown on a wholesale plan. Several suggestions based upon methods which have been employed will therefore be useful:

(1) It is possible to finish the curing of these stocks on shelves put up temporarily in the field. These can be covered with canvas or corrugated iron, for all that is necessary is to keep off the sun and rain.

(2) In regions having very dry summers where the bulbs come out of the ground dry, the merchantable stock can be taken out in the field as the bulbs are picked up directly out of the windrow and put into slatted crates for the market. The crates can be stored in well-aerated open sheds until the time for shipment arrives. The planting stock can then be put on shelves in the bulb house. When handled in this way drying must be well done in the field or the bulbs are likely to mold in the pack.

(3) The most certain method is to put the bulbs on shelves in a bulb house where all conditions are under control. This is the method which has been employed by the Department of Agriculture and probably will be the one mostly in use by small growers, especially where large numbers of varieties are grown or where the varieties grown are expensive ones. It is realized, however, that in large operations with medium-priced varieties the expense of housing in this way is heavy, so that some cheaper handling may have to be devised.

The methods necessary in handling in storage will vary with the conditions. In the Puget Sound region it is necessary to be rather careful about drying the bulbs well, and it has been found that 8 inches deep on the shelves is about the limit. It takes two weeks to completely dry off the roots after the bulbs have laid three or four days in the windrow. In the District of Columbia region, however, the drying will occur in half the time. In the Santa Cruz region in California little attention is paid to the drying of the bulbs.

One may see here piles of Paperwhite Grandiflora bulbs 2 to 3 feet deep on shed floors. But here the bulbs come out of dry soil and all roots are dead at digging time.

In the South the bulbs are often spread out under the magnolias and live oaks. They take the rain as it comes and are cleaned off at some dry period and shipped, planted, or stored in sheds in piles. One grower transfers them into bean hampers (conical stave vegetable containers) and piles these up where they can be protected from sun and rain by canvas or even cross-cord paper.

The form and arrangement of the bulb house is the same for a great variety of bulbs. The stocks can be stored in trays or on solid benches made of any tight lumber. They are piled on these 6 to 10 inches high, depending upon the moisture content, ventilation, and somewhat upon the size of the bulbs, larger stock going on deeper than the smaller sizes. The expense of housing is indicated by the fact that it takes 2,000 to 3,000 feet of shelving to hold the crop from an acre farmed intensively.

CURING

The term "curing" of daffodil bulbs, as of tulips, is a misnomer. The process as referred to generally consists in simply drying the bulbs at a comparatively low temperature to such an extent that they will not mold or otherwise become injured in the pack. This consists simply in drying until the roots are dead and the coats have lost their moisture. The bulbs are then safe in moderate masses, say 2 feet through, if aeration around the packages is provided.

The whole process is purely unnatural and is necessitated by the artificial commercialized condition of handling. In nature the bulbs are subjected to no such conditions. It is well to bear this in mind and to remember that the whole process of "curing" and ripening is an artificial necessity in order that the bulbs may be handled without injury.

CHANGES IN THE BULBS AS THEY DRY

When daffodil bulbs are first dug on the heavy soil of the Puget Sound region after they have been in two years they are mostly dark in color. As they dry for a few hours to a day or two in the windrow the brown to tawny coats become slightly exposed. When shaken in the shakers preparatory to being removed to the bulb house a great many of the old blackened coats are abraded off and the bulbs are much lighter in color. When placed on the shelves, therefore, they are much brighter in appearance, but the roots are commonly still green; and the snouts, which in many varieties are likely to be more or less putrid from the sloughing off of the old leaf bases, have not completely dried up.

When dug, the propagation in the form of slabs on the sides of the mother bulbs may be close and quite firmly attached. These, or many of them, loosen and spread apart as the bulbs dry on the shelves, so that three or four weeks later most of the fresher coats are exposed. This exposure and the drying of the coats themselves, together with the abrading of the blackened remains of the old outer covering, cause the bulbs to present their true marketable appearance in various shades of light brown or tawny so characteristic of these

stocks. (Pl. I, figs. 2 and 3.) The real shade of color varies greatly with the variety, the nature of the soil in which the bulbs are grown, and somewhat on the method of handling, especially upon the length of time they remain in the soil after maturity.

BREAKING THE BULBS APART

The process of separating the planting from the merchantable stock necessitates the breaking of the bulb clump, as in tulips. Here also it is advisable to take out the large bulbs by hand. (Pl. IV, fig. 2.)

In imported stock the bulbs commonly but not always have their roots removed, rendering the stock somewhat neater in appearance. (Pl. I, figs. 2 and 3.) This was the invariable practice before the World War, but now much of the importation is with the roots on. All this root removal, which should be done if at all at the time the clumps are broken, is a slow, laborious process which is believed to be unnecessary. It is all hand-work, consumes more time than the other part of the operation, and it is believed that it can be dispensed with.

FIG. 1.—Bulb of Victoria, showing at the left the basal plate of the split pulled out

The separation of the bulbs varies greatly with both the condition of the stocks and the variety. Some varieties are much harder to get apart than others. Slabs round off and are more easily separated if grown to the right point of development before being dug. Such forms as Autocrat, for example, round off and make the basal separation much quicker than Sir Watkin, which is the most difficult to handle in this respect. Stocks have been seen which were nearly ruined by having the separation carried too far. It would be better to plant clumps and let them come apart naturally than to carry this breaking process too far. Bicolor Victoria is another variety which is likely to be injured by careless removal of the slabs.

In Victoria and also in Sir Watkin the slabs may sometimes be well spread from the bulbs and still attached so firmly by the bases that the basal plate of the slab actually pulls away from the bases of the scales and leaves the slab or propagation without a base (fig. 1). As a result of careless breaking in these varieties the flat slabs rot the next year, but as they rot small bulblets are commonly formed in their angles. These are so small that it takes three or more years for them to flower. The only way to avoid injuries of this kind is to use care in the breaking of the stocks or to plant without separating the tight slabs.

Some Netherlanders use a knife and actually cut the bases in Sir Watkin. This is very laborious and is believed to be decidedly in-

jurious to the stocks. It is better to plant the clumps and wait for nature to make the separation, which will take place without a serious wound and with less injury to the bulbs.

SIZERS AND SIZING

As stated elsewhere, the separation of the merchantable from the planting stock, which involves also the breaking apart of the bulb clump, is essentially handwork. The operations can not be done by any machinery yet invented. This accomplishes a large part of the sizing, and in practice it is believed that the separation of the large bulbs can best be done at the time the clumps are broken, as in tulips.

In commerce there are three main qualities of these bulbs, depending partly but not wholly upon size: (1) Double nosed, (2) first size, and (3) second size. The first will usually give two flowers, the second is the largest single-flowered bulb, and the third is a smaller flowering size. In all of these categories there is a flexible rather than a fixed standard of size, for each category is variable and must differ with the variety and also with the conception and integrity of the seller. It also varies from year to year with the crop.

The separation of the merchantable from the planting stock at the time that the clumps are broken is described here because in the writer's experience it is economy to make the separation at this time. The further separation of the salable stock by some mechanical sizer into the three categories mentioned above is considered elsewhere, but perfect segregation of the double-nosed bulbs is difficult to make mechanically because some double-nosed bulbs may be smaller than first-size single-nosed ones, necessitating again considerable handwork. The process, however, is not so laborious as its discussion would indicate, and it must be considered a matter of as great importance in the bulb industry as are close sizing and grading in the various fruit industries.

In these experimental investigations the only sizer now used is one consisting of a series of parallel bars in the form of a grating. (Pl. IV, fig. 1.) The series of bars form the surface of an inclined plane about 16 feet long, having a compartment under each separate grating for the reception of the bulbs that pass through that grating. The bulbs are worked by hand over this series of bars, one man working on either side of the incline. Only the planting stock is handled in this machine.

Attention should be called to the difference in performance between this form of sizer and one consisting of round perforations in a parchment or other thin plane. The grating measures the shortest diameter of the bulb, while the round hole measures the longest diameter in the case of somewhat flattened bulbs. Another difference is likely to be overlooked from the fact that in the use of the ordinary parchment sieves used for sizing tulips and described in a previous bulletin[3] the bulbs take the size of the sieve on which they are caught, while in the grating they take the size of the grating through which they pass. In order to make the two systems more comparable it is necessary to step the grating system down 1 centimeter, or one size, in order to approximate the round perforation.

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[3] Griffiths, David. The production of tulip bulbs. U. S. Department of Agriculture Bulletin 1082, 48 p., 20 pl. 1922.

Daffodil bulbs, on account of their peculiar shapes, do not lend themselves well to mechanical sizing, especially to the round-perforation sizer. In order to handle these in the latter at all it is almost necessary that the roots be removed, which is a time-consuming task.

To summarize, the tendency has been toward the use of a grating sizer for daffodils and to make the separation into merchantable bulbs and planting stocks at the time the clumps are broken apart. In the last four or five years no roots have been removed from either the turn-off or planting bulbs. The handling at planting time is a little more difficult, but it is considered that the roots well dried down are an assistance rather than an injury to the bulbs in the pack.

This discussion, or much of it, as will be readily realized, has no application in regions with very dry summers nor with Polyanthus culture in warm regions, for there the roots disappear.

DRAINAGE AND SOIL PERCOLATION

To produce daffodils successfully the water must get away from the plants quickly after a rain. Bad drainage, resulting from the configuration of the surface or nature of the soil, will spell disaster. Good stocks of Empress have been ruined on heavy plastic soil when planted in beds 50 feet long with open 2-foot ditches on the sides and across the lower end, even when there was a surface fall of 4 feet in 100, but the drainage was 150 feet lengthwise of the plats.

On the other hand, stocks have been known to succeed when under water for a considerable period on sandy soil where the downward percolation of the naturally well aerated water was rapid. Soil which produces grain or even vegetables well may not be suited at all to the production of narcissus bulbs because we are dealing here with a winter crop. To plant bulbs in autumn and let them take the conditions that obtain in the soil in winter is a very different thing from planting crops in the same soil worked up in the spring after it dries out sufficiently to be handled. In order for the soil to be suited to daffodil production it above all things must not be wet and soggy in winter, for it is then, more than in the spring and summer, that stocks suffer. The bulbs can not root in water. There is little difference between planting in water and planting in soil so heavy and plastic that it is slow to let water through. This applies to the group in general, but it is not to be understood that the varieties all suffer alike under the adverse influence of poor drainage and retentive soil conditions. Scattered through this bulletin are references to varieties which suffer more than others from heavy soil and bad drainage.

The early symptoms of lack of aeration in the soil caused by its excessive fineness or too much stagnant water are blackened outer coats of the bulbs, which later gradually disintegrate. This is followed by a blackening of more coats and a rotting away of the base to such an extent that the whole plate is destroyed. Then, of course, the whole bulb rots unless a fragment of the basal plate is left undecayed. On the approach of dry weather in summer such a fragment will round off and form a small but perfect and healthy bulb again in an endeavor to go on and grow the next season.

To put this matter briefly, the culture of daffodils should not be attempted where the soils are in such condition that the water will not drain away readily to a depth of 20 to 24 inches. The Poeticus group and its derivatives can withstand more moisture than the others.

USE OF LIME

The recent experimental work in growing daffodils has been conducted on soils fresh from the forest whose floor is usually acid. Lime has been consistently applied a year or more in advance of a tulip crop, the application being 2 tons of ground limestone to the acre. The daffodils have followed tulips. The results detailed here have obtained under these conditions. No records have been made in comparison with no liming. It is thought that daffodils would get along fully as well without the lime, for it is usually conceded that they are injured by too much of it.

FERTILIZERS IN COMMERCIAL CULTURE

It is always the safest plan for the grower, unless he has had enough experience to be considered expert in daffodil culture, to see to it that the ground planted is sufficiently fertile, i. e., is moderately fertile for ordinary crops without the addition of any manures at the time of planting. If such land is not to be had the safer plan is to apply manure, grow some other crop on it the first year, and then plant daffodils. It is not intended to convey the idea that it is not possible to apply manure to this crop at the time of planting, but only that it is fraught with danger unless it be done with rare judgment. If it is done, it should be done in moderation. The manure should be well decomposed and very fine, so that the incorporation can be well-nigh perfect; otherwise basal rots are likely to be induced by the action of the fermenting particles in the soil, from the effect of which the young roots soon decay, and this decay extends to the base of the bulb.

If the daffodil grower is also handling tulips he has a good index in this crop. Soil which has sufficient fertility to properly produce a crop of tulips will usually have sufficient plant food left in it to maintain a crop of daffodils the next year without the addition of any more manures unless the soil is very leachy. Additional fertility can then be safely added during the rooting season the second year as a top-dressing. At this time even raw manures applied in moderation are perfectly safe. The application of raw manures as a top-dressing the first year can also be done at the same season if considered necessary.

The records of the Department of Agriculture on this point are yet meager. One good biennial crop has been produced on new ground out of the forest with the incorporation of an oat crop turned under and without manure. Another crop has been grown after tulips on similarly prepared ground, but with 12 loads of mainly rotted hay to the acre applied before the tulips. In this case the daffodils were planted with no fertilizer a month after the tulips were dug, but a dressing of 4 tons of pulverized sheep manure to the acre was applied and worked in with a wheel hoe in September of the second year. It is considered that this application of fertilizer

was moderate under the circumstances and that it was imperative for good production. The results the second year were not so good as the first, for the reason probably that the forest débris had gone out to a large extent, allowing the soil to get more plastic.

DAFFODILS A BIENNIAL CROP

It may be accepted as an axiom that daffodils resent being disturbed annually. This can be used to advantage in cheapening the production of these bulbs. The planting stock should be so sized and selected that it will develop into a maximum of merchantable bulbs and a complement of planting stock to put back. Objections have been heard that stock left in two years is angular and not rounded and symmetrical nor as pleasing to the eye. This feature can be disregarded when it is known that bulbs with flattened sides perform as well as round ones. In the final analysis it is flower production that is the measure of the value. Only in certain sizes are imported bulbs nicely rounded off, and they are obtained mainly by hand picking the stocks.

It is possible, of course, to have the bulbs in the ground three years, when there will be a large increase and fewer merchantable ones. These when set out for a year round off and make fine symmetrical bulbs, but the advantage of an annual digging period is not apparent when injury to stocks is considered. Of course, the grower may find it desirable at times to plant big bulbs, get his large increase the first year, and dig and plant a large measure of bulbs which will come to the round stage in another season; but when economy of time and space, coupled with equal performance, are considered, the advantage, it is believed, is with the biennial practice. The situation in the case of Paperwhite Grandiflora is different. This variety comes along more rapidly, and it is believed that annual digging is with it the proper practice.

CULTURE FOR CUT FLOWERS

For the production of cut flowers the bulbs are left undisturbed for a longer period. The planting and other handling, however, need not necessarily vary, but in this country the planting is made in single or narrow matted rows far enough apart to admit of horse cultivation. In such a planting the bulbs are left undisturbed for three or more years, the maximum yield of flowers being obtained about the fourth year, depending upon the fertility and care used in general culture and handling. In the Virginia region the bulb plantings are of indefinite age.

When bulbs are dug under this kind of treatment there are no merchantable stocks and the bulbs are numerous and small. After resetting, it takes a correspondingly longer period for the planting to reach its maximum production again in proportion as the stocks have been reduced in size by being left in the ground too long. In the Virginia region it is estimated that it takes a plantation three years to come into bearing. Just where the point of greatest advantage is in the period of digging is not known, for no records have been made of the comparative results. The probability is that when yields over a term of years are taken into consideration a period of four or five

years will be found to be about the maximum under intensive culture. When, however, plenty of room is allowed, such as is common in clumps and borders in ornamental plantings, good yields are often obtained for an indefinite number of years where good fertility is supplied. Indeed, naturalized plantings 100 years or more old are common, and they still produce.

HARVESTING FLOWERS

In general, it may be maintained that the production and marketing of flowers is the business of the bulb consumer rather than that of the producer. From a business point of view it is rare that both jobs can be well done by the same individual. Besides, when production obtains generally, the producer who markets flowers is interfering directly with the business of his main client. Of course, one aspect of the case is that many a young narcissus-bulb producer feels that he must have the additional revenue from the cut flowers in order to get by at all. It may be that for a time this added revenue, while the business is small, will be the means of enabling some of our growers to get established.

In the free-for-all competition and the development of the growing business in widely scattered centers, as is now probable, and the practicability of shipping the cut blossoms across the continent, it is not possible to predict what aspects these features of the business will assume in this country. All that can be done now is to call attention to them.

So far as the effect on the plant and its future production is concerned, the cutting of the flowers with a maximum of stem, as is common, has, in the writer's opinion, only a slightly deleterious effect on bulb yield. Contrary to the case of the tulip, the narcissus cut is considered decorative without the inclusion of green leafage or with green from some other source, but the flower stem of the daffodil functions as a leaf, and its removal deprives the plant of close to 10 per cent of its elaborating surface. The effect, however, is much less pronounced than in the tulip when leafage is removed.

REMOVING THE FADED FLOWERS

In tulip culture the removal of the flowers as they fade is necessary, but in daffodil culture there is no such imperative requirement. It must be confessed, however, that there seems to be some difference of opinion, for the evidence given by the foreign bulb grower is contradictory. So far as the experience of the writer goes it is immaterial whether the flowers are pulled off or not. No case of injury from disease has been seen from leaving them on, and the seed production is almost nil, so what can be the object of the extra labor? In a few varieties which make seed abundantly the advantage is plainly seen, but with the average run of daffodils no such advantage is evident.

APPEARANCE OF THE FLOWER SPIKE

The customary way to test the quality of a consignment of daffodil bulbs is to cut open a few in order to determine the presence or

absence of a flower, which can usually be plainly seen at planting time. This is the test of the novice, however, rather than that of the experienced bulb grower. The latter knows quite accurately when a variety has reached the size to flower, and he also knows that a bulb will flower when it reaches that size. The experienced grower knows without sacrificing any bulbs whether they have flowers in them. The only point for which he needs an examination is to determine whether the flower has been killed by bad treatment. This can be determined only by dissection.

The fact is that a daffodil bulb which has been grown with approximate decency has a flower in it when it has reached flowering size as certainly as a normally developed pod has peas in it.

At the time of digging, however, unless the digging is delayed, it is not commonly possible to see the flower with the naked eye. It develops within a few weeks, depending upon the temperatures in storage, and by the last of August it may be a half inch or more long. If the bulbs are held at low temperatures it may not develop much for two or three months.

DIFFERENCE IN COST OF VARIETIES

The method of sizing and planting designed to get an even distribution of plant material on the ground has been given in detail on another page. The larger the bulb the more space must be given to it for development. As an illustration, the planting stock of Empress is very large and must be set 7 or 9 and none over 14 bulbs to a row, while the planting stock of Pheasant's Eye in these experiments in 1919 was all set 21 bulbs to a row. In both of these cases merchantable stocks were produced in two years. In the case of Empress planted 9 to a row the turn off could not have been more than 9 bulbs in 1921, but in the case of Pheasant's Eye it was 21 bulbs or more, or two and one-third times as many. Many comparisons of this kind are possible. The fact that a variety produces a large bulb makes it comparatively expensive to grow.

Another cause of expense in varieties is paucity of reproduction. Desirable varieties which reproduce slowly must be high priced in comparison with those which give abundant increase. The white trumpet Madame de Graaff reproduces abundantly, while Peter Barr is shy with its offspring and is also a larger bulb. The latter, if for no other reason, must remain high priced, while the former is a cheap bulb. To the average individual Madame de Graaff is also about as desirable a flower.

SPECIAL ITEMS

VICTORIA SPLITS

Instead of dividing and making a large bulb 10 centimeters or more in circumference by the division of the mother bulb, Bicolor Victoria will rather frequently divide into a large number of what are sometimes called ring splits or "horse teeth." Eighty or more bulblets are sometimes formed from a single bulb. What really happens in this excessive propagation is a division of the bulb scales into numerous flat or angled uncoated bulblets (fig. 2). Netherlanders usually advise that such bulbs are "weakened" and should be discarded.

The first time such a propagation showed itself excessively in the department stocks was in a planting of large Victoria bulbs set in the fall of 1914 and dug in 1916. Of these 15,000 were separated and planted about 50 to the row in August, 1916. In two years they had reached 8 to 13 centimeters in size. To insure flowering it was found that a 12-centimeter bulb was necessary, although an 11-centimeter one would usually blossom, but not always. Subsequent years showed that these mostly split normally after they grow up to about 15 centimeters. This 1916 stock is still carried and is scarcely distinguishable from the parent stock or from selections of normally split bulbs made at the time.

The objection to growing the small splits is the length of time it takes to do it. With proper fertility they can be planted 50 to the row and left two years. At this rate, 50,000 to 60,000 occupy only one-sixteenth of an acre. At the end of two years they can be dug and reset 14 and 21 to the row, and at the end of another year they are marketable as single-nosed bulbs. When space, labor, and scarcity of stock are considered, it is not at all certain but that it will pay to grow small splits rather than throw them away. Of course, when the ring splits are very prevalent in any stock it can not be marketed, and whether or not a grower plants his small splits will depend on whether he considers it more economical to take the regular smaller number of large offsets or the larger number of small ones with a longer period for their development.

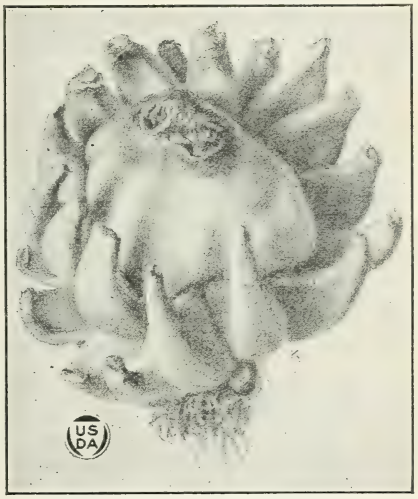

FIG. 2.—Bulb of Victoria divided into numerous small, angular, naked splits

GREEN FLOWERS

For some reason not understood there is a tendency for the flowers of several of the double-flowered forms of daffodils to turn green. The most notable case is that of Double Van Sion, which all through the eastern United States not only turns green but the trumpet and perianth split to such an extent that the flower is of little or no value after the year of importation. Even the first year from the Netherlands a goodly percentage of the flowers often come green, and those yellow in color and of good trumpet are seldom more than a small percentage. (Pl. V, fig. 2.)

This indicates that Netherlands conditions are far from ideal and that even the Dutch with generations of experience are not by any means able to produce the flower perfectly. The writer is informed that with them the percentage of green and badly split trumpets varies from year to year, as it does on Puget Sound. So far as it is possible to judge, there is little difference between the quality of the

stocks of this variety from the Netherlands and those from Bellingham, Wash., when grown on soils adapted to it.

While it is not understood what causes such behavior, there seem to be several contributing factors. Heat and drought during the dormant period are possibly the most potent contributing factors, and proper fertility and soil conditions, especially with reference to drainage and porosity, are also important. There seem to be indications that greater perfection is attained at higher altitudes. It is said that the variety requires heavy soil, but the Whatcom silts underlain by an impervious clay at a depth of 15 to 16 inches are not suited to it. A few indications have been seen which point to the suitability of the fine, fertile, porous river-bank sandy silts of the Pacific Northwest.

Besides Double Van Sion, some of the Double Incomparabilis and occasionally even the Double Campernelle (Pl. V, fig. 1) are offenders in this respect. At times Sulphur Phoenix gets quite green and some of the other varieties as well.

After flowers of Double Van Sion have turned green in the eastern United States it takes about three years to bring them back to the perfection of normal stocks in the Bellingham region.

It is very evident that a great deal can be accomplished by selection in the maintenance of color, as well as perfection of trumpet. Both the perfect and half-split trumpets have merit. The characters, however, have not persisted under our methods and soil conditions, and one does not feel certain of his ground in making selections and trying to maintain them.

PAPERWHITE GRANDIFLORA

The most important item here and in some respects the most important single variety in the entire group is Paperwhite Grandiflora. It has been successfully produced on the coast of California, in southern Georgia, and in northern Florida. There are other sections where it can be grown.

In the culture of this variety about the same methods of handling are employed in California as in southern France. The bulbs are set rather closely in rows about 15 inches apart. They are carefully sized into progenies which will reach maturity in one or two years. Most of the American culture thus far has been for dual purposes, bulbs and cut flowers, and often the bulbs are left for three years undug when there is little or no merchantable stock.

Clean culture is practiced for the most part, and the cultivation is done mainly with a wheel hoe. The digging is usually done with a spading fork, or at times the bulbs are plowed out and then picked up from the furrow slice. The handling of this variety need not be essentially different from that of the daffodils in general except that annual digging usually obtains in commercial bulb production. Like bulb crops generally, this requires heavy fertility. Lack of appreciation of this fact has been the cause of more failures in the production of these bulbs than any other one factor.

A great deal of complaint has appeared, most of it deservedly, regarding stocks of Paperwhite Grandiflora which have found their way to the market from those grown in this country in recent years. The failure of such bulbs has been taken in some quarters as proof of the unsuitability of American conditions to the production of

these stocks. The real trouble has been lack of knowledge of what constitutes good stock. In one case a grower deliberately selected his largest bulbs with two to four or more noses to send to the florist. They were selected from stock left in the ground three years. When forced these bulbs produced four or more shoots each and but little blossom. The bulbs of smaller size which this grower planted for propagation flowered well, and similar bulbs that were single nosed sent to another florist were pronounced good.

A dividing bulb (three or four nosed) of a trumpet daffodil has decided advantages, for it will usually give two flowers, but not necessarily so with the Paperwhite Grandiflora. Here, from the point of view of the florist at least, the most desirable is a maximum-sized bulb which has not yet marked off its future excessive divisions. Usually this is a split or slab rounded off by one or at most two years of culture under good conditions. A tight two-nosed bulb will often throw two flower spikes, but when three or four small divisions are seen when the bulb is cut across it is common for none of them to blossom.

CHINESE SACRED LILY

Little is known in this country about the methods of production of this variety. Under the treatment given it here the bulbs are commonly indistinguishable from those of Paperwhite Grandiflora; that is, they become rounded off, hard, and firm instead of the angular and mostly flabby clumps of the imported stocks. The indications are that they are produced in China on rather heavy soils, with an abundant supply of moisture. A Florida grower has recently produced bulbs very comparable with the imported stock. The key to the riddle, it is said, is again plenty of fertility.

VARIETIES REQUIRING SPECIAL CARE IN HANDLING

Care should be the watchword in handling all daffodil bulbs, but the grower will soon learn that some varieties are much more easily bruised than others. The varieties which have received the greatest injury and which are now treated with special care are Horsfieldii, Madame Plemp, Sulphur Phoenix, and at times Van Waveren's Giant. These seem especially liable to injury in the writer's experience and commonly arrive in bad condition from abroad. When carefully handled, however, there is no difficulty in getting the bulbs across this continent in unbroken lots by freight in the ordinary slatted crate. The bulbs of these varieties can not be shaken roughly in cleaning, and care should be exercised in the use of shovels and in dropping them into containers. When so handled there is no difficulty with them.

ALBA PLENA ODORATA

This is a variety that can not be flowered except in a cool and damp atmosphere. It grows and flowers to perfection in the Puget Sound region, except upon the drier sandy soils where it is much more subject to the blasted condition of the flower spike than on the heavier, moister Whatcom silt loams. The success of John H. Umpleby in producing the variety in northern New York proves the adaptability of that region. One instance of its successful flowering and culture has come under observation in Tidewater, Va. This is on moist, silty soils where it blossoms before hot

weather. Full flowering, however, is seldom seen. Wherever observed the blasted flower spikes are numerous. The successful production of bulbs with normal flowers in them which can be blossomed in the proper environment is not difficult. First-class bulbs can be grown in regions where they seldom open a flower.

The writer was very much impressed some time ago to find the variety growing vigorously in southern Indiana. No one had ever seen a flower of it, but the characteristic blasted flower spikes were in evidence everywhere. The indications seem to be that that region produces normal bulbs, but that it is too hot and dry for the flower spike to open. In the region of Washington, D. C., it is seldom that a perfect flower is produced.

GOLDEN SPUR

The most used of any of the long-trumpet daffodils is Golden Spur. There may be as many bulbs of this used as of all other long trumpets combined. In point of numbers compared with all the varieties of the genus Narcissus its use is exceeded by Paperwhite Grandiflora only. On account of the very large numbers used for forcing and the habit, almost universal in America, of destroying the bulbs as soon as they have flowered in the greenhouse, the world has become short of stock of this variety. It has not seemed possible for the Dutch growers to produce it fast enough.

Golden Spur is one of those varieties which does not reproduce rapidly, is not overstrong in constitution, and requires rather more special conditions for its best production than many others. The experience of the Department of Agriculture in the Pacific Northwest shows conclusively that it can not be grown on the Whatcom silt loams of the region with any satisfaction. On the black sandy loam of the Fort Bellingham, Wash., location, however, it is considered a success.

During the past three years some good stocks have been produced in a small way by three growers, all located on moist, low, sandy, well-drained, fertile or well-fertilized areas. It is believed that this formula is the one necessary for the production of prime stocks of this variety. One of these growers, who produced the best Golden Spur bulbs the writer has ever seen, grew them on river-bottom sandy silt loam, not far from the river bank, where the coarsest material is deposited by the flood waters and where the structure of the soil is practically the same for 6 feet or more. There may possibly be some substitutes which can be used for this variety should it become still more scarce.

Whether the variety is going to be as important in the immediate future as in the past no one can say. At present King Alfred is taking its place to some extent, but this, although a grand variety, is 10 days later under forcing conditions, and stocks of it will probably also be scarce for 10 years to come.

Henry Irving does somewhat better under adverse conditions in the Pacific Northwest and blossoms a few days earlier. Its color, however, is not so good as that of Golden Spur.

The old Single Van Sion or Trumpet Major, of which there are large naturalized stocks in the country, is a good early forcer. It might also be used as a substitute after about three years of culture

under good conditions. This also is not as deep a yellow as Golden Spur, which has supplanted it for that reason.

ENEMIES

The enemies of daffodils are few in number, and only one really serious pest has been observed in this country.

The injury by the larger narcissus fly (*Merodon equestris* Fab.)[4] is done in the larval stage, the grub burrowing through the bulb and destroying it. The grubs can be detected and destroyed at planting time. They are about half an inch long and one-fourth of an inch in diameter and occur singly in the bulbs (fig. 3). The adult, which is seldom seen, somewhat resembles a bumble bee. A practical method for destroying the insect has not been completely worked out in this country. Hand picking the bulbs is quite efficacious in maintaining a measure of control, but it does not eliminate the pest. This is not so difficult a process to apply as it may seem, for there is usually some evidence, such as a rotten base or perforated apex to the bulb, to suggest visually the presence of the insect. To the feeling, bulbs occupied by the grub are light in weight and mostly soft to the touch. Some of these evidences are sufficiently pronounced to enable one to cull the stock and throw out most of the infested bulbs.

FIG. 3.—The grub of the greater narcissus fly in a bulb which it has about destroyed

The most approved Dutch method of general treatment of narcissus bulbs for this fly as well as for the nematode is known as the hot-water treatment. In its simplest, most approved application a tank heated by steam or hot water is employed. Suspended within this is another tank in which the bulbs are placed for treatment. A constant temperature of the water in the inner tank is maintained at 110° F. for 1½ to 3 hours, depending on the size of the bulbs treated.

Experience shows that if the grower has planted bulbs infested with this fly he can do a great deal toward getting rid of the pest very early the next spring as the plants are coming up. Bulbs infested by the fly will be weak, throwing up only one or two weak leaves. Such bulbs can be rogued out and destroyed. This work must be done early before the grubs leave the bulbs and while the evidence is clear.

The lesser narcissus fly (*Eumerus strigatus* Fall.) in the writer's opinion does not attack healthy narcissus bulbs although commonly found not only in these bulbs but in many other genera as well. The hot-water treatment will kill the larvæ of this insect also.

The status of the lesser narcissus fly has not been studied sufficiently in this country to establish its relations to other crops, such as the onion. In an experience of seven years with it the

[4] The information here given has been approved by the Bureau of Entomology. In case further information on the bulb flies is desired, consult Weigel, C. A., and E. R. Sasscer, Insects injurious to ornamental greenhouse plants. U. S. Dept. Agr., Farmers' Bul. 1362, 81 p., 91 fig. 1924.

writer has seen no evidence to indicate that it attacks healthy narcissus bulbs, but that it commonly follows mechanical and other injuries which cause the bulbs to rot.

The eelworm disease has received a great deal of publicity in England, less in the Netherlands, and appears to be of still less significance in America, where a much safer rotation of crops on new soils is feasible. This disease is detected by irregular raised areas and finally lesions on the leaves in the growing condition, also by discolored rings and streaks in the bulbs. The active stage of the organism occurs as the weather becomes warm in the spring. The only preventive measure which is said to give satisfaction is the hot-water treatment already described (p. 23).

Rigid rotation, coupled with cutting the leaves off at the surface of the ground in severe infestations and destroying them when the parasite is most active, is to be recommended. Cutting the leaves off in this way will check the bulbs some, of course, but they will recover before the end of another 2-year period. This will aid greatly in the clean-up of the stock. After this the bulbs should be dug and reset on clean ground and most carefully culled.

The gray disease is a malady that is little understood. The name is one that comes from the Netherlands. It is looked upon by the bulb grower as not a disease at all but as a weakened condition of stock. It manifests itself by an uneven distribution of the green coloring matter of the foliage of the daffodil, causing a streaked appearance and a lighter color of the foliage in mass, the individual leaf being streaked with yellowish rather than bright or glaucous green. Plants affected never recover their normal coloring and are ever after weaker than normal ones. In these respects, and in the additional characteristic that seedlings come clean and free from the striped condition, the behavior suggests the mosaic disease. All stocks the writer has ever seen of some varieties are broken or have the gray disease. Others seem to be addicted to the trouble.

There is no known remedy. The only thing that can be done is to true up one's stock by roguing out the so-called gray individuals and then keeping the stocks in as vigorous condition as possible. The disease has been eliminated from Princeps in the Department of Agriculture stock by roguing and also by growing from seed. Sir Watkin is much subject to the trouble both here and in the Netherlands. Although they vary greatly, stocks are seldom seen which are entirely free from it.

WHERE NARCISSUS BULBS ARE GROWN

All of the groups except the tender Polyanthus varieties are capable of being flowered over a very wide range of territory. The statement in a recent commercial list, "popular wherever there is spring," is a catchy and suggestive way to express the wide area over which they may be enjoyed. They are grown to-day, both cultivated and naturalized, from Canada to Florida and from Maine to California, and some varieties persist almost indefinitely over a large part of this territory when naturalized.

The production of commercial stocks for the market, however, must be confined to narrower limits. On the whole, the climate of the Pacific Northwest is probably superior to any other considerable

area in the country, but the middle Atlantic Coastal Plain seems well suited, as does also the Tennessee, Illinois, and Indiana section. At present there is great activity in Michigan, where soil of suitable texture is abundantly available.

The Polyanthus group, on the contrary, with the exception of the Poetaz section, is generally tender and must be confined in its culture to the warmer sections, such as coastal California and the Gulf coast region. The greatest activity in their production up to this time has been the California coast as far north as Humboldt County, but more particularly from the San Francisco Bay region to Santa Cruz, where they are used mainly in the cut-flower trade, although good bulbs have been produced. In the South there has been longer experience in southern Georgia and northern Florida than elsewhere. There are indications that an occasional frost which cuts the flowers does not necessarily inhibit the production of good bulbs, especially of Paperwhite Grandiflora. The indications are, therefore, that the areas adapted to the production of these bulbs are wider than has heretofore seemed probable.

RELATIVE USE OF VARIETIES

The varieties of the genus Narcissus which are used in quantities by florists are comparatively few in number. At the head of the list must be placed Paperwhite Grandiflora, produced mostly now in the warm climate of southern France. The next in importance to this is doubtless Golden Spur, which has two features which recommend it, a fine color and its early forcing quality. After these two in point of quantity come Emperor, Double Van Sion, Victoria, Empress, Glory of Sassenheim, Joss Flower (Chinese sacred lily), Grand Soleil d'Or, Conspicuus, Princeps, Sir Watkin, Ornatus, Madame de Graaff, and a number of other varieties of lesser use. In recent years both King Alfred and Van Waveren's Giant have come to the front remarkably. Both are still too high priced, and the stocks of them are too limited for first quantity use, but florists are using all they can get of them now, and it is thought that their use will continue to increase unless some of the newer varieties come forward to replace them. There are many other good forcing varieties, of course, but it is believed that these have the greatest use.

The varieties employed in garden and naturalized field decoration alone have a large use also, and it is believed that such employment is on a rapid increase, but the numbers employed for these purposes are small compared with the numbers used for forcing, largely because out-of-door plantings persist year after year, while the forcing stocks are purchased anew each season.

BREEDING DAFFODILS

Breeding daffodils is a big subject and can be only touched upon here. It is broached at this time simply because it is barely possible that some seedlings produced here may serve better than imported stocks. This has been true with our fruits and may prove to be equally so with the daffodil. It is fully realized that some may think that this subject is quite exhausted after so much work has been done, but this is far from the fact in the case. There are already one or two

cases of accomplishment in this country, and so far as the British are concerned it is those who have been in the work the longest who are the most enthusiastic about the possibilities.

As a suggestion to those who would get their hands in, so to speak, on the breeding of daffodils, the following notes on seeding qualities of a few varieties which have been observed may be of service. At Bellingham, Wash., the following varieties seed well: King Alfred, Van Waveren's Giant, Great Warley, Glory of Noordwijk, Weardale Perfection, Ard Righ, and Obvallaris. Princeps also seeds freely and comes mostly true from seed. Emperor, Golden Spur, and Henry Irving seed rather sparingly. At Washington, D. C., King Alfred, Van Waveren's Giant, Hoboken, Herald, Vanilla, Herrick, Conqueror, Crispa, Harbinger, Commandant, Laura, Tresserve, and Princeps seed quite freely. Emperor seeds sparingly.

NATURALIZING VARIETIES

There are a few notable examples of the naturalizing of daffodils in this country. They are mainly on estates in the East, in Tidewater, Va., near Cincinnati, Ohio, and to a less significant extent in other sections. In most cases the venture has been for ornament and pleasure, although that in Virginia is strictly the commercial production of flowers.

The accumulation of stocks by planting and allowing the fields to be overrun with grass for a period of years is a most desirable and commendable thing to do, particularly if the product in years to come finds its way into commerce again. There are many varieties which are susceptible to this sort of handling. The list of these includes most varieties which have a very large use in the trade. During such handling the bulbs dwindle in size, but they reproduce well and seem to regain vigor and healthfulness by the lack of handling for a period of years. After this sort of treatment they vigorously come up again to merchantable sizes under cultivated conditions. This sort of treatment is actually resorted to abroad in the maintenance of stocks of some varieties. This suggests what may be necessary in this country before we attain the fulfillment of our needs in narcissus stocks.

YIELDS

To visualize the yield in a narcissus crop is one of the most difficult tasks. This is because both the stock planted and that dug are so variable in size, and the multiplication must of necessity be in numbers of bulbs, for this is the basis on which they are always sold or estimated in this country. Any estimate of yield, therefore, must presuppose on the part of the reader a large degree of familiarity with the stocks. It presupposes that he is able to translate numbers into size and coordinate the two intimately related factors. Table 1 gives the actual performance on Whatcom silt-loam soils underlain with an impervious clay at Bellingham, Wash.

In a study of this table the reader is reminded that section 1 relates to small bulbs and section 2 relates to large bulbs. The yields shown were obtained on Whatcom silt loams which are not adapted to produce either the quality or the quantity obtained on

more friable loam soils. In comparison with this, Table 2 shows the behavior of poorer planting stocks on Lynden sandy loam sod land planted to daffodils following tulips which were planted the first year after the sod was broken. These stocks were grown by Howard Houser, who planted the culls left on the shelves after the Department of Agriculture had finished its plantings.

TABLE 1.—*Yields of small and large stocks of narcissus bulbs on Whatcom silt-loam soils at Bellingham, Wash., in the years stated*

Name of variety	Size planted (centimeters)	Total number of bulbs planted		Turn off in 1921
		1919	1921	
SEC. 1.—Small bulbs:				
Ard Righ	6 to 8	3,045	3,031	1,600
Beauty	7 to 8	903	490	1,000
Conspicuus [1]	6 to 10	4,326	6,086	4,640
Double Van Sion [2]	7 to 10	174	482	
Elvira	6 to 10	28,112	10,676	22,310
Emperor	8 to 12	2,728	2,276	2,090
Figaro	6 to 8	1,477	917	1,435
Frank Miles	6 to 8	896	1,043	1,000
Glory of Leyden	6 to 10	5,059	2,474	3,600
Golden Spur	6 to 10	1,897	1,208	1,060
Do	6 to 10	1,603	1,189	2,100
Horsfieldii	6 to 10	6,102	4,809	4,400
J. B. M. Camm	6 to 8	1,255	1,358	1,200
J. C. Backhouse	8	714	658	1,200
John Bain	6 to 8	3,437	1,897	2,510
King Alfred	7 to 12	132	197	20
King of the Netherlands	6 to 8	2,751	2,247	2,750
Madame de Graaff	6 to 10	2,905	2,644	3,250
M. M. de Graaff	6 to 10	1,428	1,329	1,200
Madame Plemp	7 to 10	8,197	5,924	6,944
Minnie Hume	6 to 8	3,976	3,388	2,565
Mrs. Langtry	6 to 8	5,503	3,927	4,810
Mrs. Morland Crosfield	6 to 10	2,801	1,996	2,260
Obvallaris	6 to 8	3,815	4,004	2,510
Ornatus	6	4,620	4,690	3,850
Pheasant's Eye	6	3,885	12,285	20,820
P. R. Barr	6 to 8	1,274	847	1,000
Sulphur Phoenix [3]	8 to 10	8,127	2,852	4,500
Victoria [4]	7 to 10	5,880	1,850	6,000

Name of variety	Number of bulbs planted [5]			Turn off in 1922
	1918	1920	1922	
SEC. 2.—Large bulbs:				
Campernelle (single)	1,440	4,050	3,050	2,000
Emperor		3,192	3,234	1,250
Glory of Noordwijk [6]	2,894	6,808	11,441	
Golden Spur	1,078	4,647	4,837	1,500
Great Warley [7]	510	1,180	1,380	
Henry Irving	2,038	4,198	3,983	1,900
King Alfred [8]	1,599	2,691	3,240	
Klondike	1,017	3,335	3,689	1,250
Madame de Graaff	1,008	3,135	2,205	1,700
M. M. de Graaff	1,001	2,529	2,975	1,250
Mrs. Langtry	1,056	3,322	4,214	1,335
Van Waveren's Giant [9]	1,682	9,974	11,513	
Weardale Perfection	1,512	4,672	5,695	
White Queen	504	1,460	2,862	

[1] Selected free from gray disease.
[2] Selected to good trumpet form.
[3] Can not maintain itself on heavy soil.
[4] Selected to normal splits.
[5] The 1918 plantings were first-size to double-nosed bulbs except Emperor, which were slabs.
[6] Dug and reset in 1923 when there were 12,326 bulbs of all sizes.
[7] Dug and reset in 1923 on account of being on heavy soil. The stock had dwindled to 1,251 bulbs.
[8] Not only on too heavy soil but was injured by being subjected to too low temperatures when imported.
[9] Dug and reset in 1923 when there were 15,536 bulbs of all sizes.

TABLE 2.—*Yields of narcissus stocks on Lynden sandy loam soils at Bellingham, Wash., in the years stated*

Name of variety	Total number of bulbs planted			Bulbs sold in 1922
	1919	1920	1922	
Double Van Sion	1,595	2,982	3,590	200
Horsfieldii	451	673	1,008	
Madame Plemp	385	544	1,075	100
Princeps	660	1,424	1,429	1,000
Sulphur Phoenix	572	967	1,113	250

Growers without previous experience are likely to make very grave errors in their computations of yields. Some such errors are familiar to the writer. The wrong estimates result from computations based on prime mother bulbs propagated for too short a time.

The grower who contracts for double-nosed daffodils and gets not only the two-nosed bulb but the clumps as dug, including three or four noses, and bases his estimate of yield on the multiplication the first two years, is certain to be unpleasantly surprised to find the yield dropping off in later years. Even if the grower continues his culture by planting back all of his stock for five or six years he is still prone to overestimate, for the reason that when he begins to sell both round and double-nosed bulbs his yields are going to take a tremendous slump as compared with his yields when bulbs of all sizes are planted. It is only when he has learned what percentage of large bulbs it is necessary to plant back in order to maintain stocks under his conditions that he knows what to expect in the way of yield.

These circumstances have less application in the case of certain of the Polyanthus group, notably the Paperwhite Grandiflora, for with them the multiplication is much more rapid. They have less application in certain varieties, such as Recurvus and Conspicuus, in which it is usually possible to turn off what one plants and have abundant stock to replant the same area at each 2-year period. It is very different, however, with the big trumpet forms.

CONDITIONS OF DAFFODIL CULTURE

Fortunately, the experience of the Department of Agriculture in these experiments has been varied enough, it is believed, to demonstrate quite conclusively the conditions suited to bulb production in this genus.

The work was begun on a 10-acre tract, approximately half of which was a sandy loam and the other half Whatcom silt underlain with clay. For the first years the stocks were grown part of the time on the friable soil and part of the time on the heavier loam. The results were fairly satisfactory, considering that comparatively low fertility was maintained. The bases stayed in the bulbs, but they were not of prime quality. In 1916 nearly all the stocks were moved to sandy loam which had never been planted to bulbs but had been farmed since the early settlement of the region. It was in a fair state of fertility. The best bulbs produced during these investigations were during the 2-year period under these conditions.

FIG. 1.—SINGLE AND DOUBLE CAMPERNELLE.

These are very desirable fragrant flowers that do well and are deserving of being grown more extensively.

FIG. 2.—DOUBLE VAN SION.

Upper, perfect trumpet form; lower, left to right, half split and completely split trumpets. The first two are desirable forms.

THE LARGE TRUMPET DAFFODILS.

Upper, left to right, Weardale Perfection, King Alfred, Glory of Noordwijk; lower, Olympia, Van Waveren's Giant. The comparative height and comparative length of leafage are shown.

FIG. 1.—THE BICOLOR TRUMPETS.

Upper, left to right, Van Waveren's Giant, Mrs. Walter T. Ware, Empress, Victoria; lower, Horsfieldii, Mrs. Morland Crosfield, Glory of Noordwijk, Madame Plemp. Comparisons can be made of height of variety and relative length of stem and leaf.

FIG. 2.—THE WHITE TRUMPETS.

Upper, left to right, Madame de Graaff, Mrs. Camm; lower, J. B. M. Camm, Peter Barr. The illustration shows the comparative length of stem and the relative height of leaf and stem.

FIG. 1.—THE LARGEST INCOMPARABILIS.

Great Warley.

FIG. 2.—DOUBLE INCOMPARABILIS, SULPHUR PHOENIX.

This is one of the best of the group.

FIG. 1.—THE POETS.

Left to right, Almira, Ideal, and Ornatus.

FIG. 2.—THE POETAZ GROUP.

Upper, left to right, Klondike and Aspasia; lower, Elvira.

In 1918 and 1919 the stocks were again planted on Whatcom silt loam of a depth of about 14 inches. The results the first two years were fairly satisfactory, but since that time the stocks, as a rule, have not behaved as they should in either reproduction, quality, or general healthfulness, although good fertility has been maintained. It is thought that the measure of success the first two years on this soil was due, in part at least, to the large proportion of forest débris which held the soil in better tilth than it has been in later years.

It is not to be inferred that all the varieties have behaved alike. The forms of the Poeticus group and its derivatives which have been grown have succeeded admirably. Ornatus, Recurvus, Alba Plena Odorata, and Poetaz Elvira have been a decided success under all circumstances.

All this, be it remembered, relates to the production of bulbs. There has never been a time on any soil when the floral display in the spring was little if any short of perfect. So pronouncedly and uniformly good have been the floral displays each spring that keen plantsmen have been loath to believe that the daffodils were not adapted to these heavy soils. It is fortunate, in a way, that circumstances have been such as to permit the making of a demonstration so decided.

NARCISSUS VARIETIES AND THEIR CLASSIFICATION

The varieties of narcissus are exceedingly numerous, and unlike many other genera of plants the natural species are still prized and cultivated so far as they are obtainable and adaptable to cultural conditions. In 1887 William Baylor Hartland[5] listed in his catalogue about 140 garden varieties. Kirby[6] in 1907 listed about 525. Robert Sydenham[7] in 1913 described nearly 1,300 varieties, while the Daffodil Nomenclature Committee[8] of the Royal Horticultural Society in 1916 listed about 2,800 names which have been applied mainly to garden varieties of this genus.

In the bulb catalogue of one of the leading Dutch firms for 1923 nearly 200 varieties are offered for sale. While 200 may be taken as a fair average of the offerings of commercial concerns, no two firms agree throughout in the list of varieties offered, and it would be a comparatively easy matter to-day to procure twice this average number of varieties, with a negligible number of synonyms.

Each year sees scores of new names published representing horticultural varieties recently bred. Some of these, it may be confidently predicted, will become leaders when better known and the stocks become available. The greatest activity in breeding in this group is in the British Isles and the Netherlands, but investigations are by no means wanting in other parts of the world.

All the more pretentious and reliable commercial lists since 1914, the date of the first issue of the report of the Daffodil Nomencla-

[5] Hartland, William Baylor. Hartland's "original" little book of daffodils, oxlips, cowslips, and primroses. 28 p., illus. Cork, Ireland. 1887.

[6] Kirby, A. M. Daffodils, narcissus, and how to grow them . . . 235 p., 32 pl. New York. 1907.

[7] Sydenham, Robert. All about daffodils and narcissi. Ed. 3. 144 p., 4 pl. Birmingham, Eng. 1913.

[8] Royal Horticultural Society, London. Daffodil Nomenclature Committee. Classified list of daffodil names. 83 p. 1916.

ture Committee, arrange their lists of offerings more or less in conformity with the classification laid down by that committee.

The outline of classification, with examples, is as follows:

Division 1.—Trumpet daffodils. Trumpets as long as or longer than the perianth segments. (Pls. VI and VII.)

(*a*) Varieties having yellow, self-colored, or nearly self-colored flowers: Emperor, King Alfred, Golden Spur. (Pl. VI in part.)

(*b*) Varieties with white trumpets and perianth: Madame de Graaff, Peter Barr, Mrs. Robert Sydenham. (Pl. VII, fig. 2.)

(*c*) Bicolor varieties. White or nearly white perianth and trumpet, some shade of yellow: Empress, Victoria, Glory of Noordwijk. (Pl. VII, fig. 1.)

Division 2.—Incomparabilis. Chalice cupped, in which the crown is one-third to less than the length of the perianth segments.

(*a*) Yellow varieties: Sir Watkin, Gloria Mundi.

(*b*) Bicolor varieties: Great Warley, Lady Margaret Boscawen. (Pl. VIII, fig. 1.)

Division 3.—Barrii. Cup less than one-third the length of the perianth segments.

(*a*) Yellow varieties: Conspicuus, Glitter.

(*b*) Bicolor varieties: Cossack, Lady Godiva.

Division 4.—Leedsii. Perianth white with cup white or white tinged with yellow to apricot. (Pl. II, fig. 2.)

(*a*) Cup one-third to less than the length of the perianth segments: White Queen, Lord Kitchener.

(*b*) Cup less than one-third the length of the perianth segments: Evangeline, Mrs. Langtry.

Division 5.—Triandrus hybrids. All varieties containing *Narcissus triandrus* blood: Queen of Spain.

Division 6.—*Narcissus cyclamineus* hybrids.

Division 7.—*Narcissus jonquilla* hybrids, such as Golden Sceptre and Odorus Campernelle, single and double.

Division 8.—*Narcissus tazetta* (Polyanthus) and its hybrids (Pl. IX, fig. 2): Paperwhite Grandiflora, Soleil d'Or, Elvira.

Division 9.—Narcissus Poeticus varieties (Pl. IX, fig. 1): Ornatus, Cassandra, Recurvus.

Division 10.—Double varieties of all groups. (Pl. VIII, fig. 2, and Pl. V): Telamonius Plenus (Double Van Sion), Phoenix varieties.

Division 11.—Various botanical species: *Narcissus bulbocodium*, *N. viridiflorus*.

There seems to be a tendency among the traders to-day to discard very largely the subdivisions of this classification, to list the Incomparabilis, Barrii, and Leedsii groups together, separated by brief descriptions, and to separate the recent hardy Poetaz group, or hybrids of the Poeticus and Polyanthus divisions, from the latter.

RECOMMENDATIONS

Plant narcissus bulbs on a friable and preferably sandy loam soil of sufficient depth to insure good drainage. An occasional period on a heavier loam will be beneficial.

Dig and replant biennially except the prolific varieties of the Polyanthus group. An occasional 4-year or 5-year period undisturbed will improve the stock.

Do not hesitate to use for propagation naturalized stocks or those which have been used for bedding or forcing if they appear to be in good condition.

Do not sun the bulbs, but dry them in a well-aerated, shady place or under débris in the field.

Plant early, before the end of September if possible. Before the end of August is none too early.

Do not think the bulbs can be roughly handled because they are well coated and do not show bruises readily.

Provide good fertility, but let it be neither excessive nor raw.

Be constantly on the lookout for a single large grub (greater narcissus fly) in a bulb. Use every means to eliminate it. Numerous small grubs (lesser narcissus fly) in rotted bulbs are to be looked upon as a consequence and not the cause of the rotting.

Practice rigid rotation. Let two years intervene between two successive crops on the same land.

Remember that the sale of all the big bulbs is incompatible with the maintenance of stocks in the large trumpet varieties.

Do a good job of farming. This crop will respond quickly and make returns on the extra care.

Consider very carefully the varieties which are to be grown.

Do not allow cheap or nonsalable varieties to accumulate unduly simply because planting stock is available. Better sacrifice such material than to spend money growing it.

Do not jump at the conclusion that stocks are diseased because they are (1) not growing or reproducing well, (2) have coats blackened, (3) have eroded bases, (4) have some rotten bulbs present when dug or on the shelves after they are dug. Think! Have the stocks been mistreated? Are your cultural conditions responsible?

Remember that excellence of stock is accomplished in the greatest measure by culling out imperfect and undesirable individuals when growing in the field and in the bulb house after digging.

Experience covering two or three biennial digging periods is necessary to enable the grower to form an accurate estimate of the success of his venture in the production of this crop.

In marketing Paperwhite Grandiflora do not furnish the customer bulbs in which excessive future divisions are already laid down, but instead a round, preferably single-nosed, big, compact bulb (measuring 12 centimeters and up) which has only just come up to size, under good fertility, from a split.

Do not market small, starved, and imperfect bulbs. Grow them to maximum size. Produce them plump, fat, and firm. Such bulbs are the only ones which will create respect for the grower, be a success with the consumer, and reflect credit upon the efforts to produce home-grown stocks.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

March, 1924

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